Session: C32 Poster: W120A

Angular momentum budget analysis in the Community Earth System Model (CESM)

Christof Petrick[†]; Katja Matthes
[†] GFZ German Research Centre for Geosciences, Germany
Leading author: christof.petrick@gfz-potsdam.de

An important part of improving our understanding of the Earth's climate is the investigation of interactions between its different physical components, i.e., the atmosphere, the ocean, continental hydrology and the cryosphere. One measure of this interaction is the exchange of angular momentum between the above subsystems. Angular momentum is an integral measure of Earth system dynamics and a convenient way to evaluate the quality of a coupled Earth system model. On timescales from hours to decades, the exchange of angular momentum between the atmosphere-hydrosphere system and the solid Earth cause small variations in Earth rotation, which can be measured precisely with recent space geodetic techniques. However, it is generally very difficult to balance the atmospheric and hydrospheric excitations of Earth rotations completely. Here we evaluate the contributions of these sub-systems to the observed total excitation in a physically-consistent system, wherein total momentum, energy and mass are conserved. We have performed multi-year simulations with NCAR's Community Earth System Model (CESM), a free-running climate model which links the four physical subsystems atmosphere, ocean, land and sea ice via a numerical coupler. The atmospheric component in this study is the Whole Atmosphere Community Climate Model (WACCM) which includes middle atmosphere dynamics, physics and chemistry, up to the thermosphere (140km). The angular momentum excitation contributions from these sub-systems on seasonal to decadal time scales have been calculated separately for motion and mass terms in order to reveal significant regional variability pattern and to validate the simulated total angular momentum excitations implied by observed Earth rotational variations. Since the influence of a sub-system on the adjacent sub-system is not simply modeled by prescribing boundary conditions, but rather by considering dynamical interactions, this approach allows a more realistic representation of dynamical system processes relevant for observed Earth rotational variations. The model validation will focus on secular to decadal variations.